Orthoceras pleurotomum Barr. (*Syst. sil.*, pl. 296), which are undeniably transitions to true Orthoceras in their striae of growth and position of siphon. There is therefore convincing evidence in the structures of these Cambrian shells that the Ammonoidea, with their distinct embryos, arose from the orthoceran stock, and passed through a series of forms, in times, perhaps, preceding the Cambrian, which were parallel to those characteristic of genetic series among Nautiloidea; viz., straight, arcuate, gyroceran, and nautilian.

The researches of Emmons and Marcou in this country, and the discovery of ten thousand feet or more of stratified rocks under the Cambrian by the U. S. geological survey, and the inferences of Bigsby from the extended study of Silurian and Devonian fossils, are beginning to place the probable existence of a prepaleozoic period beyond question, in spite of the really grand opposition and world-wide researches of Barrande. The study of the tetrabranchs teaches us, that, when we first meet with reliable records of their existence, they are already a highly organized and very varied type with many genera, and that the name 'paleozoic,' as applied to these first records, is a misnomer. There was a protozoic period; and the tetrabranchs, like their successors, certainly must have had ancestors which preceded and generated them in this period, but of which we are at present necessarily ignorant. Whatever the future may have in store for us we cannot now predict; but at present the search for the actual ancestral form, though necessary, is nevertheless not hopeful. We can, however, rely upon the facts of embryology, and predict without fear of failure, that, when our k owledge makes this prototypical form known, it will have a decided resemblance in structure and in aspect to the earlier stages of the shell as observed in the fossil cephalopods.

(*To be continued.*)

SCALES OF COLEOPTERA.

SOME of the more interesting forms of scales of Coleoptera described in the paper by Dr. George Dimmock, noticed in *Science*, i. **455**, are shown in the annexed figures. The scales of the carpet-beetle, Anthrenus scrophulariae, and of the museum pest, A. varius (fig. 1), resemble in general form those of many Lepidoptera, as do also the scales of Valgus squamiger (fig. 3). The scales of V. squamiger are, however, hairy, in fact, almost shaggy. The scales of Hoplia coerulea (fig. 2) vary from round to lanceolate, those of the dorsal surface being transparent yellow when viewed by transmitted light, and blue by reflected light. Those of the ventral surface are purplish, purplish red, red, bluish, and colorless by transmitted light, while by reflected light they are silvery white, with at times a tendency to metallic green. The scales of the dorsum are smooth, filled with fine reticulations (fig. 2, *d*), but those of the ventral portions and of the tip of the

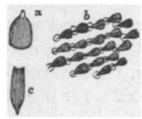

FIG. 1.

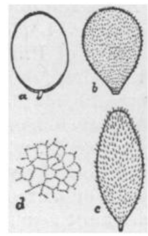

FIG. 2.

FIG. 3.

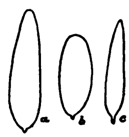

FIG. 4

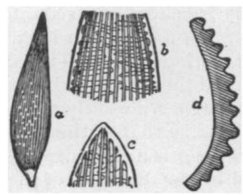

FIG. 5.

FIG. 6.

FIG. 7.

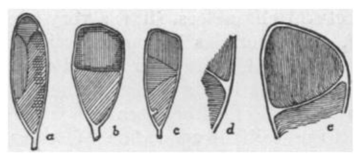

FIG. 8.

FIG. 1.—Scales of Anthrenus: *a*, of A. scrophulariae; *b*, arrangement of same on portion of an elytron; *c*, scales of A. varius. Enlargement: *a* and *c*, 100 diam.; *b*, 50 diam.
FIG. 2.—Scales of Hoplia coerulea; *a*, from elytron; *b*, from under side of thorax; *c*, from femur; *d*, fine structure to be seen in *a*, with high powers. Enlargement: *a*, *b*, and *c*, 100 diam.; *d*, 500 diam.
FIG. 3.—Scale of Valgus squamiger. Enlarged 100 diam.
FIG. 4.—Different forms of scales from Chalcolepidius rubripennis. Enlarged 100 diam.
FIG. 5.—Scales of Alaus oculatus: *a*, brown scale; *b* and *c*, portions of white scales to show cross-bands; *d*, transverse section of a brown scale. Enlargement: *a*, 100 diam.; *b* and *c*, 300 diam.; *d*, 500 diam.
FIG. 6.—Scales and hair of Ptinus? rutilus: *a* and *b*, scales from elytron; *c*, hair from elytron. Enlarged 100 diam.
FIG. 7.—Scale of Clytus robiniae. Enlarged 100 diam.
FIG. 8.—Scales of Entimus imperialis: on *a*, *b*, and *c*, vertical lines indicate blue, horizontal lines indicate carmine red, and oblique lines yellow; where two kinds of lines cross, one color is tinged with the other; on *d* ard *e* the fine lines represent the finer striation of the inner layer of the scales. Enlargement: *a*, *b*, and *c*, 100 diam.; *d* and *e*, 300 diam.

abdomen are covered with fine hairs representing the branches of the ordinary hairs of scarabaeidous beetles. The scales of Chalcolepidius rubripennis, an elaterid, are transparent brown when seen by transmitted light, but by reflected light appear bronzed blue, green, or red. Their form is seen in fig. 4. The black and white scales of Alaus oculatus (fig. 5), which give rise to the entire figuration of that curiously marked elaterid, although not of especially pe-

culiar form, are very interesting; because, in the white ones, the striations of the outer lamina, which form the corrugations seen in sections of the scales (fig. 5, *d*), are longitudinal, while the lower lamina, or lamina toward the insect, although smooth, shows transverse bands (fig. 5, *b*, *c*). In the fact of their corrugated surfaces being turned away from the insect, the scales of Alaus and of some other Coleoptera agree with the scales of Lepidoptera and Diptera. The 2-7 pointed scales of Ptinus (fig. 6), which are nestled amongst its hairs, resemble in a general way the plumules of some Lepidoptera. Most of the coloration of the well-known locust-borer, Clytus robiniae, is due to scales (fig. 7), which are of a form not rare in the longicorn Coleoptera.

The Rhynchophora or Curculionidae are the beetles on which scales most generally occur, and where they present their most brilliant coloration. The diamond beetle of South America, Entimus imperialis, often sold by jewellers on account of its brilliancy, has scales (fig. 8) and hairs which present to transmitted light various colors — usually red, blue, and yellow; often all three colors with gradations between them — on a single scale. By reflected light, or upon a black surface like that of the beetle itself, the prevailing colors are green and purple. The colors which are indicated by the direction of the lines on the figure (fig. 8 *a*, *c*) are those seen by transmitted light. When highly magnified, these scales, besides other structural characters, show a very fine striation (fig. 8, *d*, *e*), sometimes in one direction on one part of the scale, and in another direction on another part. This fine striation is probably the cause of the brilliant coloration of these scales.

All the brilliant coloration of scales of Coleoptera appears to be due to interference of light, either by fine striation, or by superposed delicate lamellae; as can be proved by wetting the scales with chloroform, when the color disappears, only to reappear as soon as the chloroform is evaporated. Most of the scales of Coleoptera contain air; and this air, together with the background formed by the coloration of the insect itself, gives rise to the various changeable hues seen in most of the Coleoptera which have scales.

MICROBES.[1]

NONE of the organic substances which form an essential part of our sustenance, and are useful in a thousand ways, can be kept for more than a few days: fermenting and spoiling, they are the despair of the economists. In this decomposition the substance becomes filled with an immense number of very minute organisms. How can a liquid, like milk or soup, free from all foreign germs, become invaded in a few hours by these innumerable legions of microbes? The first hypothesis suggested is, that all these organisms are the result of the decomposition, and that they are produced spontaneously at the expense of the altered substance. This is the theory of spontaneous generation, so vigorously maintained by Pouchet; and it is certainly one of the greatest of Mr. Pasteur's good offices, that he has refuted one by one the arguments of the supporters of this attractive theory, pursued them to their last defence with his invincible logic and his unexceptionable experiments.

The fermentation is produced by the microbes; and these, by a wonderfully rapid propagation, are derived from germs carried by the air, or adhering to the vessels which hold the fermentable liquids. The diligent researches of Mr. Miquel show that the comparatively pure air of the suburbs of Paris holds from a hundred and fifty to a thousand living germs per cubic metre. In a hospital at the centre of the capital, each cubic metre of air contains from five thousand to thirty thousand, according to the season. Although these figures appear prodigious, they are nevertheless very small, compared to the number of spores which cling to all the solid objects surrounding us. A simple cleansing is powerless to remove them: only fire or strong antiseptic solutions can destroy them. A fermentable liquid can be preserved indefinitely if it is protected from all microbes; but it is easily seen, after what we have just said, how difficult it must be to obtain this perfectly insulated state. All these lower vegetable types are found in two forms, — 1°, the vegetative or active form; and, 2°, the passive form, that is, the spores, which play here a part analogous to that of seeds in plants.

In the active state most microbes show little endurance; many species cannot stand a drying of any duration; and in moisture a temperature of 70° to 80° C., continued for two or three hours, destroys them almost without exception. Spores are more hardy: boiling water does not kill them; but, for this purpose, water must be heated to 120°, 130°, and even 150°. When dry, the spores do not succumb to a temperature below 180° to 200°; and, according to Mr. Fricz, cold of 110° has no effect upon them. To disinfect clothing without burning; would, then, be an impossibility, if, fortunately, Mr. Koch had not discovered that the germs cannot resist the action of a continued current of steam at a temperature of 100°.

It is peculiarly difficult to protect a liquid from all germs, or to destroy all those which have penetrated it; however, it is possible, and the liquid is then said to be *barren*. Certain soups are prepared in this way that they may be sown with very small particles of substances containing the microbes to be studied; and thus the desired species obtained, to the exclusion of every other. Laboratories devoted to these studies annually distribute hundreds and thousands of litres of these soups.

The organisms which here claim our attention belong to three families, all allied to fungi, — moulds, yeasts, and microbes proper. Each kind of fermentation is produced by a certain species of these small organisms, and takes place only if the species in question is present in the liquid, from the beginning of the fermentation, in sufficient numbers not to be

[1] By Dr. H. FOL of Geneva. Translated from the *Journal de Genève*.